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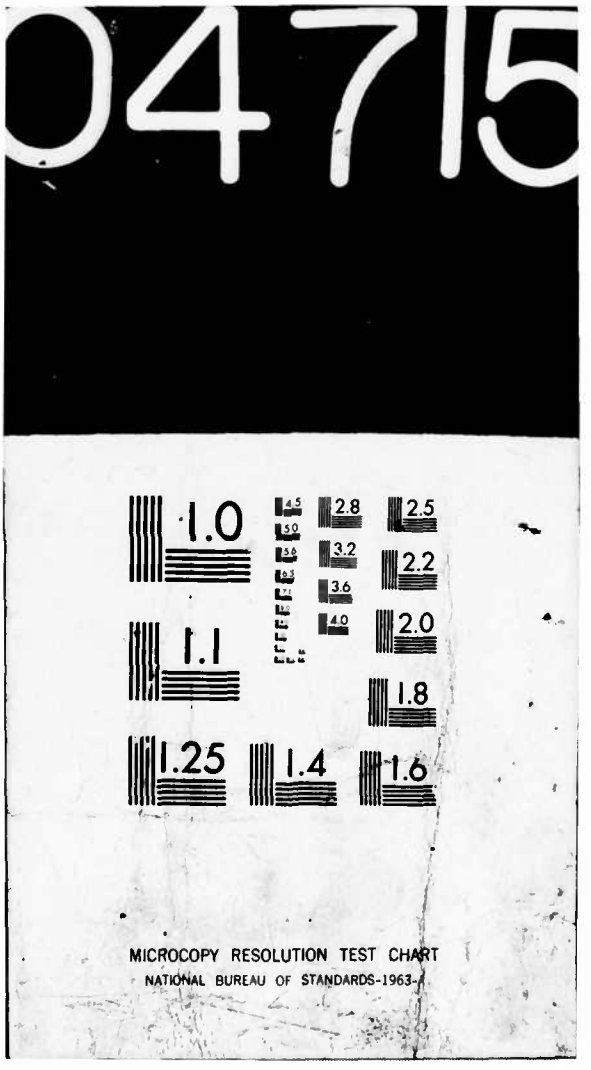
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Report No. CG - D - 65 - 77



# A PRELIMINARY EVALUATION OF LEVEL FLOTATION EDUCATION REQUIREMENTS: PEOPLE AND LABEL EXPERIMENTS



AUGUST 1976

FINAL REPORT



Prepared for

**U. S. DEPARTMENT OF TRANSPORTATION**
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16. Abstract

This report documents the preliminary work performed to test the effect of two different methods of educating boaters in the use of level flotation.

The two methods of education were: 1) a label placed in the boat stating that the boat was equipped with level flotation and 2) a lecture/slide presentation on boating safety which included a segment on level flotation.

Boater behavior in a swamping situation was observed and classified to provide a subjective data base with which the label experiments could be compared. The label experiments involved swamping unsuspecting subjects in flotation equipped boats which had labels indicating they were so equipped.

The results of the label tests indicate that occupants did pay attention to the labels and responded by taking advantage of the level flotation. The lecture/slide show did not produce evidence of learning relative to level flotation.

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# METRIC CONVERSION FACTORS

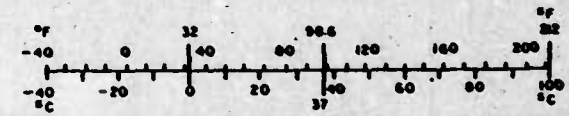
## Approximate Conversions to Metric Measures

| Symbol | When You Know | Multiply by | To Find | Symbol |
|---|---|---|---|---|
| | **LENGTH** | | | |
| in | inches | *2.5 | centimeters | cm |
| ft | feet | 30 | centimeters | cm |
| yd | yards | 0.9 | meters | m |
| mi | miles | 1.6 | kilometers | km |
| | **AREA** | | | |
| $in^2$ | square inches | 6.5 | square centimeters | $cm^2$ |
| $ft^2$ | square feet | 0.09 | square meters | $m^2$ |
| $yd^2$ | square yards | 0.8 | square meters | $m^2$ |
| $mi^2$ | square miles | 2.6 | square kilometers | $km^2$ |
| | acres | 0.4 | hectares | ha |
| | **MASS (weight)** | | | |
| oz | ounces | 28 | grams | g |
| lb | pounds | 0.45 | kilograms | kg |
| | short tons (2000 lb) | 0.9 | tonnes | t |
| | **VOLUME** | | | |
| tsp | teaspoons | 5 | milliliters | ml |
| Tbsp | tablespoons | 15 | milliliters | ml |
| fl oz | fluid ounces | 30 | milliliters | ml |
| c | cups | 0.24 | liters | l |
| pt | pints | 0.47 | liters | l |
| qt | quarts | 0.96 | liters | l |
| gal | gallons | 3.8 | liters | l |
| $ft^3$ | cubic feet | 0.03 | cubic meters | $m^3$ |
| $yd^3$ | cubic yards | 0.76 | cubic meters | $m^3$ |
| | **TEMPERATURE (exact)** | | | |
| °F | Fahrenheit temperature | 5/9 (after subtracting 32) | Celsius temperature | °C |

*1 in = 2.54 (exactly).

## Approximate Conversions from Metric Measures

| Symbol | When You Know | Multiply by | To Find | Symbol |
|---|---|---|---|---|
| | **LENGTH** | | | |
| mm | millimeters | 0.04 | inches | in |
| cm | centimeters | 0.4 | inches | in |
| m | meters | 3.3 | feet | ft |
| m | meters | 1.1 | yards | yd |
| km | kilometers | 0.6 | miles | mi |
| | **AREA** | | | |
| $cm^2$ | square centimeters | 0.16 | square inches | $in^2$ |
| $m^2$ | square meters | 1.2 | square yards | $yd^2$ |
| $km^2$ | square kilometers | 0.4 | square miles | $mi^2$ |
| ha | hectares (10,000 $m^2$) | 2.5 | acres | |
| | **MASS (weight)** | | | |
| g | grams | 0.035 | ounces | oz |
| kg | kilograms | 2.2 | pounds | lb |
| t | tonnes (1000 kg) | 1.1 | short tons | |
| | **VOLUME** | | | |
| ml | milliliters | 0.03 | fluid ounces | fl oz |
| l | liters | 2.1 | pints | pt |
| l | liters | 1.06 | quarts | qt |
| l | liters | 0.26 | gallons | gal |
| $m^3$ | cubic meters | 35 | cubic feet | $ft^3$ |
| $m^3$ | cubic meters | 1.3 | cubic yards | $yd^3$ |
| | **TEMPERATURE (exact)** | | | |
| °C | Celsius temperature | 9/5 (then add 32) | Fahrenheit temperature | °F |

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# LEVEL FLOTATION EDUCATION REQUIREMENTS: PEOPLE AND LABEL EXPERIMENTS

## 1.0 INTRODUCTORY SUMMARY

During the development of a level flotation standard some of the testing and research indicated that some form of education should accompany such a standard in order for the occupants of a swamped boat to take full advantage of the flotation available. The tests that indicated this need were several swamped boat evaluations utilizing test personnel that were not completely familiar with the flotation development project. Observations of their actions during the testing led to investigations of the objective of this task.

The objective of this task was to investigate the effectiveness of two methods of educating boaters in the use of level flotation. The two methods of education chosen were: 1) a label placed in a flotation equipped boat which indicated that the boat was equipped with level flotation and 2) a slide show/lecture on boating safety which included a segment on utilizing level flotation in a swamped/capsized boat.

Labels appear to have good potential as educational tools to encourage behavior appropriate to level flotation while the boating safety presentation did not significantly enhance the subjects' knowledge of level flotation over those who did not have the presentation. This report presents the methodology and analysis which led to the above findings.

## 2.0 APPROACH

The following approach was adopted for evaluating two methods of "education." The two methods that were selected for evaluation were: 1) a label placed in the boat indicating that the boat was equipped with level flotation and 2) a lecture/slide presentation on boating safety which included a segment on level flotation.

### 2.1 Label Experiments

In order to evaluate the effect of labels on boaters' actions, boaters' actions both with and without labels needed to be classified. Three sets of experiments were performed to provide data for this classification. The first set utilized "inexperienced" test subjects in a rough water environment. These tests were to serve as a pilot study for the second and third sets of experiments. The purpose of these tests was to classify occupant behavior in a swamping situation in boats with various quantities of flotation. They are discussed in Section 3.0.

Section 4.0 discusses the second set of tests performed, again without labels. These tests utilized inexperienced subjects in a calm water environment, and were performed to observe and classify boater behavior in a calm water swamping situation.

The third set of experiments was again performed in calm water. This time labels were placed in the boats. The behavior of the occupants of these tests was taken and compared to the behavior of the occupants in the tests without labels.

The major comparison, then, was between the second and third sets of tests, without and with labels, respectively. The tests in rough water and calm water without labels cannot be compared to draw meaningful conclusions because of several differences, as outlined in Section 4.0.

## 2.2 Lecture/Slide Presentation Evaluation

The following steps were taken to evaluate a lecture/slide presentation as a method of education for level flotation:

- Develop the lecture/slide presentation.
- Present the material to a group of test subjects.
- Test the group of test subjects on their retention of the material.
- Test o similar group of subjects to provide baseline data.
- Compare the results of the tests from each group.

Details of this evaluation are presented in Section 6.0.

## 3.0 FLOTATION AND BEHAVIOR: ROUGH WATER/NO LABEL

A series of "inexperienced people" tests were performed at the Navy Wave Tank at NSRDC in Carderock, Maryland, for the purpose of observing inexperienced persons' actions during swamping situations while in boats with different amounts of flotation. The test subjects included men, women and children with some of the groups being families.

The subjects were ferried to a test johnboat that was equipped with basic, 50/50, or 75/50 flotation[1]. The boat, with passengers, was then subjected to rough water conditions originating from wave-generating equipment. Each boat was equipped with a means of flooding the boat such that the occupants were unaware of the instigation of the flooding. This was accomplished through the use of a trap door located in the bottom of each boat and a time-delayed release mechanism (Figure 1). The trap door was concealed from the occupants by placing it beneath a seat or beneath a "dummy" floor plate. Figure 2 is a photograph of the trap door underneath the seat. The door was opened by a weight pulling on the handle holding the door closed. At Carderock, the subjects were told to pull on a line which released the weight, unbeknown to them. In later experiments, the weight was released by the experimenter by releasing it from the transom of the boat. The time delay in the later experiments was provided by air filled containers, attached to the weight, which sank slowly due to several holes being punched in them.

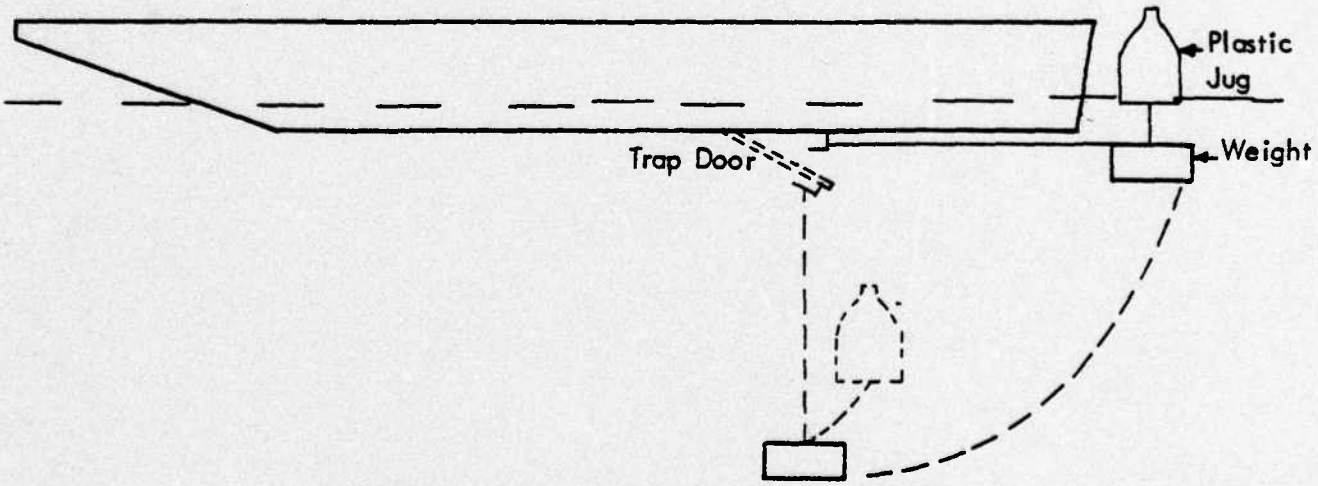


FIGURE 1. TRAP DOOR RELEASE SYSTEM

[1] These terms are explained in Appendix A.



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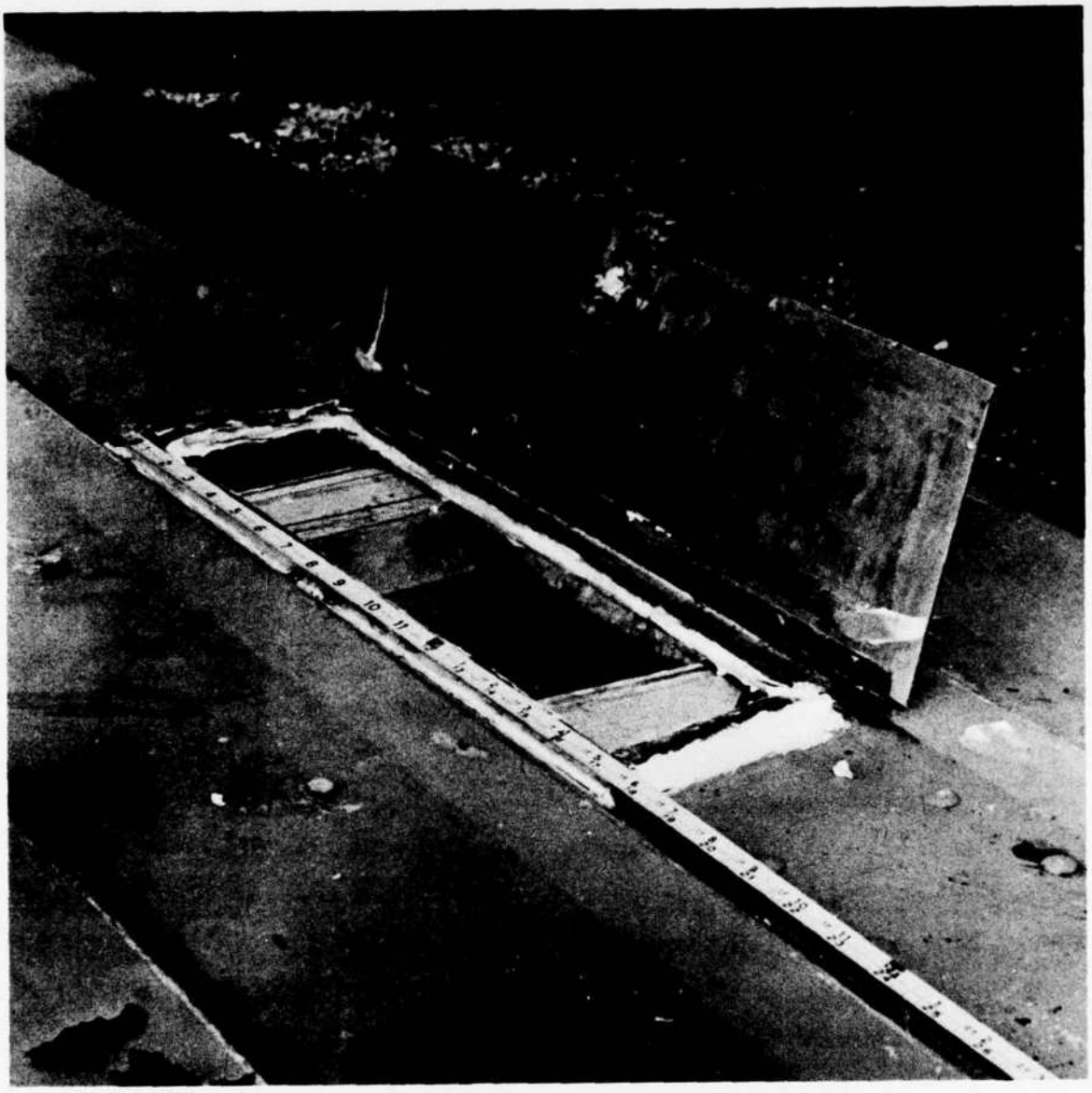

FIGURE 2. TRAP DOOR

The subjects had no prior knowledge of what was going to happen. As the rough water conditions persisted, the subjects were filmed[2] and video taped and observers noted their behavior. After five to ten minutes, the subjects were "rescued" and interviewed[3] by the observers.

Many safety precautions were taken, including:

1. All subjects were screened for general health, and all were volunteers.
2. Medical assistance was readily available at all times.
3. All subjects were forewarned of the likelihood that they would get wet.
4. All subjects wore PFDs at all times.
5. Safety rescue boats and swimmers were available at all times.
6. Radio communications were available between observers and rescue boats at all times.
7. Towels, coffee, etc., were supplied to all subjects after the experiment.
8. Subjects could elect to discontinue at any time.
9. All subjects were observed and interviewed after the experiment to be certain that they were not adversely affected.

Detailed descriptions of the tests were recorded by each observer. In addition, two interviews were conducted of each subject, one immediately after the test and one after viewing a video tape of the test. The subjects had been told that if they became separated from the boat, they would have to swim the length of the tank (over 100 yds (91.4 m)) to simulate swimming to shore. During the tests, no one left the area of the johnboat. Table 1 shows the number of subjects in various conditions.

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[2] The film is on file at Wyle and is available for review.

[3] Tape recordings of all interviews are on file at Wyle.

TABLE 1. CARDEROCK RESULTS

| Test # | POB | People Were Calm | People Sat Low In The Boat | People Were Bailing | People Were On Top of the Seats | Someone Stood Up | Some People Displayed Fear Or Anxiety | Someone Left The Boat | The Boat Capsized | Boat Description |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | X | X | X | | | | | | 75/50 L.F. |
| 2 | 3 | | X(1) | X | X(2) | | X | | | 50/50 L.F. |
| 3 | 3 | | | | X | | X | | | 75/50 L.F. |
| 4 | 4 | | | | X | X | X | | | 50/50 L.F. |
| 5 | 3 | | | X | X | | X | | X | Basic F. |

Note: L. F. stands for Level Flotation, POB stands for People on Board.

The X's in the table indicate at least one person in the group exhibited the behavior shown at the top of the column. For Test # 2, one person got low in the boat, while two people were on top of the seats. All five tests were conducted in 1-1/2 ft (0.46 m) waves.

Even though the water was rough, the inexperienced subjects capsized the boat only once, and that was when it was equipped with basic flotation. In fact, many of them suggested ways in which they tried to increase the boat's stability. One of the effects of the rough water was to cause some people to get low in the boat, to use the boat as a shield against the waves. Subjects who reacted this way often noted in the interview that the stability of the boat increased when they got low. The initial reaction of many of the subjects was to avoid getting wet. Once they realized that they could not avoid getting wet, their concern was to stabilize the boat and maintain everyone's composure. No one left the boat.

Many subects tried to stay dry by climbing on top of the seats of the boats. Most of these subjects were composed, but nervous, during the tests. The children tended to be more tense at the outset of each run. As the subjects were exposed to the rough water and learned how to cope with it, some stated that the experience was fun, for a few minutes.

## 3.1 Sample Protocal of Test Subject

The following pratocol illustrates a sample af interview responses:

What happened out there?

The boat started sinking; it had a hole in it. The water filled up.

Did yau have any idea what was going to happen before yau went aut there?

A little bit. I thought the boat was gaing ta get water in it. That's about it, but I didn't know how.

Did the wave machine surprise yau at all?...the heighth af the waves?

The heighth did, but not the fact that the wave machine was going to start. We heard the mator warming up.

Did yau think that yau were gaing to ga inta the water at any point?

We did at first when we were sitting high an the seats. Then I said let's get down low in the boat and lawer the center af gravity. Then it was pretty stable.

Was it scary at all? Da yau think the situation was realistic? Do you think it could happen in real life?

Not really very realistic. Yau cauld see all the peaple araund. There should have been same way ta hide the peaple. I guess ane af our people got a little warried, but once we got law in the boat it was pretty stable. It was really pretty easy.

What wauld yau have dane if the boat had tipped aver?

I wauld have stayed with the boat.

## 3.2 Conclusions From Rough Water/No Label Evaluation

The basic conclusions from the Carderock study, conducted in rough water, were:

1) The differences in behavior in the 50/50 and 75/50 level flotation johnboats were minimal, as can be seen in Table 1; however, the differences between level and basic flotation were dramatic, since the basic flotation test resulted in the only capsizing. However, the conclusion that level flotation boats are easier to maintain upright than basic flotation boats, by inexperienced people, is tentative at best, since it is based on very few tests.

2) The initial reactions of over half of the subjects included some fear of getting wet, and general anxiety associated with an unexpected and novel situation.

3) The rough water caused four of the subjects to sit low in the boats, while all subjects stayed with the boat and did not strike out for "shore" (as shown in Table 1). Twelve subjects climbed on top of the seats to try to avoid getting wet.

## 4.0 LEVEL FLOTATION AND BEHAVIOR: CALM WATER/NO LABEL

A series of "inexperienced people" tests was performed at Limestone Creek (tributary to the Tennessee River, near Huntsville, Alabama) in order to obtain additional data on the behavior of people in a swamping situation when they were not aware that the boat was level flotation equipped.

The "people tests" at Limestone Creek differed from those at Carderock in several important aspects. The subjects at Limestone were college-age adults, men and women (no children). Many of them were unacquainted with the others in their group. (At Carderock, many of the test groups were families.) The water conditions were calm, and the tests were run outdoors (better lighting and warmer). While the subjects knew that there were some people in the general vicinity, the safety personnel were not nearly as obtrusive as in Carderock. Several individuals, including a cameraman and nurse, were camouflaged on shore less than 100 yds (91.4 m) from the test boat. The ferrying boat was hidden nearby and manned, and a runabout, which appeared to be merely cruising nearby, was also a safety boat. Other precautions were taken as outlined in Section 3.0.

The tests at Limestone included the 50/50 and 75/50 level flotation johnboats. At Carderock, there had been no discernable difference between 50/50 and 75/50 boats in terms of behavior in rough water. These tests were being performed in calm water to determine if this was also true under calm conditions.

The subjects at Limestone were led to believe that they were participating in a study of visual distress signals. They were directed to sit in an anchored boat and watch the shore for visual distress signals. Two signals were presented to each set of subjects to encourage their belief in the task description. The distress signal task was a diversion to keep the subjects occupied until the boat was swamped.

The boat was swamped through the use of the trap door mechanism described in Section 3.0. The delay allowed the operator of the ferrying boat to take a position out of sight around a nearby point of land. From this position, he could observe the subjects and readily come to their aid if needed.

The test boats used at Limestone were both 12 ft (3.7 m) long with a beam of 55.6 in. (141.2 cm). Since the objective of the experiment was to determine the occupants initial reactions, the exact load/flotation relationship was not critical. For each test, either two or three subjects were in the boat. A total of eighteen subjects were used in seven separate test runs, as shown in Table 2.

TABLE 2. LIMESTONE RESULTS

| Test # | POB | Bailing | Signalling/ Yelling | On Top of Seats | Standing | Anxiety/Fear | Capsized | Stayed With Boat | Swam For Shore | Attempted To Reright | Pulled In Anchor | Tried Motor | Remained Calm | Sat Low In The Boat | Paddled For Shore | Boat Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | X | X | X | X | | X | | X | | | | | | | 75/50 L.F. |
| 2 | 3 | X | | X | X | X | X | X | | | X | X | | | X | 50/50 L.F. |
| 3 | 1 | | X | X | X | X | | | X | | | | | | | 75/50 L.F. |
| 4 | 3 | X | X | | X | | X | | X | | | | | | | 50/50 L.F. |
| 5 | 3 | X | X | | X | | X | X | | | | | | | | 75/50 L.F. |
| 6 | 2 | X | | | X | | | | | | | | | | | 50/50 L.F. |
| 7 | 3 | X | X | X | X | | X | | X | | | | | | | 75/50 L.F. |

Note: All tests were in calm water, POB stands for People on Board, L.F. stands for Level Flotation.

The data in Table 2 were gathered by direct observation and verified by reviewing movies made of the experiment. As Table 2 indicates, all of the subjects stood up to get out of the water, and in five cases, this contributed to causing the boat to capsize. Ten out of eighteen (56%) of the subjects attempted to swim for shore, while the remaining eight (44%) stayed with the boat. In Test # 6 the boat sank very slowly and the two subjects never caused the boat to become very unstable. They were picked up without even attaining even a fully swamped predicament. The "remained calm" column was difficult to judge because many subjects displayed nervous laughter and voiced concern for their predicament.

The subjects at Limestone behaved as if they were much more surpised at the sinking of the johnboat than those at Carderock. This was probably due to the introduction of the distress signal task. At Carderock, the subjects knew they were going to get wet, while at Limestone, they believed that they were merely watching for distress signals. The subjects yelled for help, signalled, and sometimes attempted to swim for shore as shown in Table 2. There were no clearly discernable differences in behavior between the 50/50 and 75/50 johnboat tests within the data in Table 2.

The interviews of the subjects after the experimental incident were handled in a similar manner as in Carderock.

## 4.1 Calm Water/No Label Test Summary

What follows is a summary of major points raised in the detailed accounts of the experiments and the interviews.

The subjects at Limestone (in calm water) stood up and behaved much more vigorously (signalling) than those at Carderock (rough water). This led to numerous capsizings. These subjects frequently (56%) tried to swim to shore, unlike those at Carderock. Subjects commented that the shore looked close enough to be easily reached, when, in fact, it was approximately 100 yds (91.4 m) away. The subjects started for shore, and then experienced difficulty in swimming that far. Several stated that they felt their PFD hindered swimming. In other research[4], Wyle has discovered that while subjects may express some dissatisfaction in trying to swim while wearing a PFD, they feel the PFD may be a help in general. This is especially relevant since the Limestone subjects misjudged how easily they could swim to shore. It is possible that the Limestone subjects incorrectly attributed some of their difficulty to the PFD in order to avoid embarrassment. Some said that if they couldn't have seen the shore, they would not have left the boat. Some, upon discovering that they could not make significant progress toward shore, returned to the boat.

[4] Doll, Theodore J., et al. Personal Flotation Device Research - Phase I. Wyle Laboratories for the U. S. Coast Guard. Contract DOT-CG-42333-A. July 1976.

The Limestone subjects all behaved in a similar manner. If one subject in a group swam for shore, they all did. In Carderock, the similar behavior could have been due to so many subjects knowing each other and communicating throughout the incident. At Limestone, the subjects did not know each other well. When they entered the water, the conversation dealt with each other's ability to swim, and not with planned courses of action. In spite of the relative lack of communication, these subjects behaved in the same way, even to the point of simultaneously starting to paddle the boat toward shore. The second test group was interesting in their attempts to get to shore via paddling or the engine, and the fact that they pulled in the anchor. They were the only group to attempt to locomote.

Two interview questions that were asked of each subject led to interesting answers. When asked when or how they noticed that water was coming into the boat, 72% noticed on their own (sometimes not until the water reached their knees), while 28% were informed by another subject on the same boat. Thus, over a quarter of the eighteen subjects were distracted enough by the visual distress signal task that they did not notice the leak in the boat, according to the interviews.

When the subjects were asked what they did or were planning to do, 44% were going to or did stay with the boat, while 56% decided to try to swim for shore. When the subjects were interviewed on the shore after the tests, the interviewer would often call their attention to the fact that the boat never sank. The subjects who swam for shore felt that the boat was going to sink and definitely would have if they had re-entered it. It is possible that this statement concerning sinking was a rationalization of their behavior. No one bothered to attempt re-entry after leaving.

## 4.2 Sample Protocol of Test Subject

The following protocol is a sample of these gathered at Limestone Creek.

In progress...

You were hoping someone would come and rescue you and also thinking about getting out of the boat because you had a life jacket on. What would you have done if you had not

had a life jacket?

I would have swam for the closest thing floating. I did not trust the boat to float at all.

The boat is sinking and no one is coming to help, what did you think was going to happen then?

I was going to swim to shore.

Before you fell in, when no one was reacting to you, you were standing up and waving, what did you think was going to happen?

I thought I would drown eventually, so I tried to figure out what to do.

How did you wind up in the water? How did you actually come to be in the water?

As the boat was beginning to sink, we realized it was sinking, so we deliberately got out of the boat.

So you're in the water. Were you thinking about getting back in the boat if it did not sink all the way? Were you going to sit there and wave, or swim in?

My first impression was to try and swim to shore. I was not progressing too much, so I was waiting for help. There was no help coming and I saw the boat was still floating. Eventually I would have gone back to the boat.

What do you think would have happened then?

The boat would have sunk with my weight and the rest of the weight on it.

You think it would have gone all the way down?

I think it would have gone all the way down.

What would you have done if you had gone back and tried to get in the boat and it sank?

I would have really been depressed then. I was not making progress. I was making effort to get to shore, but it seemed as if I wasn't moving fast enough, so, really, I was distressed.

It is curious that the subject left the boat for shore, realized he couldn't have made it, and would have returned to a boat that he believed would have sunk. Though this scenario sounds illogical, it does represent the feelings of several of the subjects at Limestone.

Figure 3 shows a typical scene at the Limestone experiments, with the subjects realizing that they are in trouble and attempting to get someone's attention.

FIGURE 3. LIMESTONE SUBJECTS

## 4.3 Calm Water/No Label Conclusions

The major conclusions of the Limestone tests were: 1) there is no behavioral difference readily identifiable in Table 2 induced by the stability differences between 50/50 and 75/50 johnboats, and, more importantly, 2) inexperienced people do not tend to make proper use of level flotation in a capsizing/swamping situation. Indeed, the subjects saw the flotation taped in the boat and those who swam to shore (56% of the subjects) persisted in believing the boat would sink.

## 5.0 LEVEL FLOTATION AND BEHAVIOR: CALM WATER/FLOTATION LABEL

The last set of level flotation experiments took place for two days on Guntersville Lake in Northern Alabama. The subjects for the Guntersville tests were college-age adults, as they were at Limestone. The testing procedure was very similar to that used before. A single 50/50 johnboat was used. The subjects were instructed to look for visual distress signals on the shore line. They were ferried out to the test boat, and were observed and filmed as the test boat swamped. In the Guntersville tests, level flotation labels were put in the ferrying johnboat and the test boat. There were two or three subjects in each test; a total of twenty-six subjects were used in nine test runs (as shown in Table 3, following Figures 4, 5, and 6).

The first label used is shown in Figure 4. Its dimensions are 3 x 5 in. (7.6 x 12.7 cm) with black lettering on a yellow background. Although at least one person in every test group saw this label, often it was only one. Midway through the first day's testing, larger labels were added to the test boat. These labels measured 5 x 7 in. (12.7 x 17.8 cm) and, again, were black on yellow (Figure 5). The swamping mechanism was not triggered as soon as the subjects were in the anchored boat. Instead, they were allowed to sit in the boat, idle, for several minutes. This gave them time to look around the boat by not immediately focusing their attention on the shore line. They were told that the signals were being readied during this time. Every subject saw the labels using this procedure. The position of the labels in the boat can be seen in Figure 6.

As can be seen from the figures, the labels that were used were very graphic. They attempted to depict two men sitting low in a swamped johnboat.

The same safety precautions were used at Guntersville as had been used before. In addition, a safety boat was positioned nearby with two supposed fishermen on board who were actually observing the subjects. There were other boats in the area which were not part of the experiment. When any of these came into the immediate test area, they were informed as to what was going on. On one occassion, one unsuspecting pair of fishermen came to the rescue of one set of subjects as they were swamping.

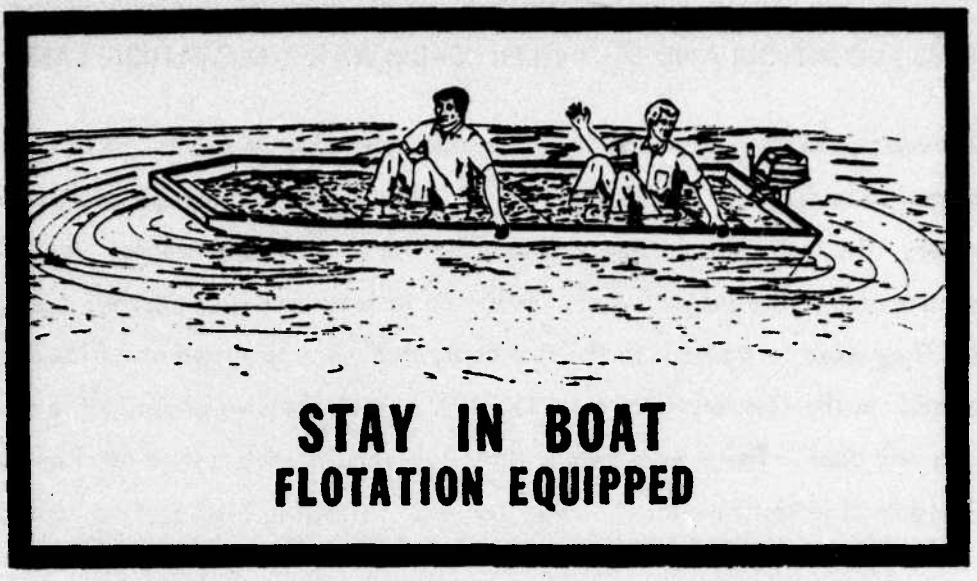



FIGURE 4. SMALL FLOTATION LABEL (ACTUAL SIZE)

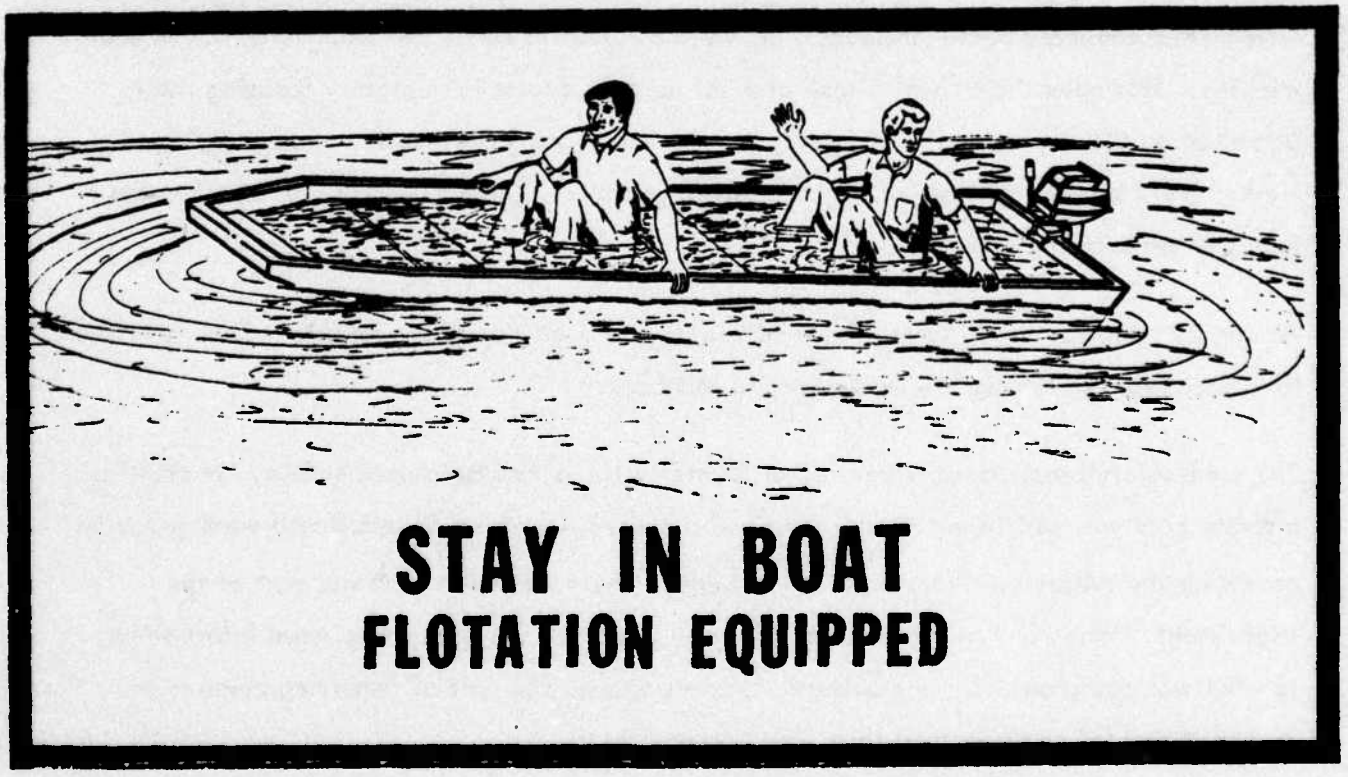



FIGURE 5. LARGE FLOTATION LABEL (ACTUAL SIZE)



(22)


FIGURE 6. POSITIONS OF LABELS IN BOAT



(40603)

(23)

TABLE 3. GUNTERSVILLE RESULTS

| Test # | POB | Bailing | Signalling | Sitting On Top of Seats | Standing | Anxiety/ Fear | Capsized | Stayed With Boat | Swam for Shore | Attempted to Reright | Pulled In Anchor | Tried Motor | Remained Calm | Sat Low In Boat | Paddled For Shore | Rescued By Outside Parties | Fell Overboard/ No Capsizing |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | X | X | X | X | | X | X | | | X | X | | | X | | |
| 2 | 3 | | | X | | X | X | X | | | | | | | | | |
| 3 | 4 | X | X | X | | X | | X | | | | | | | | X | |
| 4 | 3 | | | | X | X | X | X | | | | X | | | | | |
| 5 | 2 | X | | | X | X | X | X | | | | | | | | | |
| 6 | 2 | X | | X | X | | X | X | | | | | | | | | |
| 7 | 3 | X | X | X | X | | X | X(2) | X(1) | X | X | | | | | | |
| 8 | 3 | X | | | X | X | | X | | | | | | | | | X |
| 9 | 3 | X | | X | X | | X | X | | | | | | | | | |

Note: All tests used a 50/50 level flotation johnboat, POB stands for People on Board.

The third test group was rescued by some nearby fishermen before the test boat was completely swamped. However, these subjects were getting anxious about the situation. In the seventh group, two subjects stayed with the boat after the capsizing while a third tried to swim for help. In the eighth group, all the subjects fell out of the boat, but the boat didn't capsize. As before, the "remained calm" column was difficult to judge because many subjects displayed nervous laughter and concern over their predicament.

The data in Table 3 were gathered by direct observation and verified by reviewing movies made of the experiment. The Guntersville subjects' behavior, as shown in Table 3 and the interviews, was similar to that of the Limestone subjects, to a point. They noticed the incoming water only when it was ankle deep or higher. They then alerted their comrades and began to get higher in the boat. They often stood up to wave and yell (33% of the cases), or, at least, squatted on the seats (67% of the cases). However, when the Guntersville subjects entered the water, whether by capsizing or falling out of the johnboat, all but one stayed with the boat. They hung onto the sides, and yelled for help. Standing up was a contributing factor to six of the capsizings.

During the interviews, the subjects indicated that their behavior was definitely influenced by the labels. Usually, the subjects mentioned the labels in the interview before the interviewer asked about them.

The same type of interviews were conducted with these subjects as with the Limestone Creek subjects. Two additional questions were asked concerning the labels. Figure 7 is a copy of the interview questions. Parentheses contain instructions to the interviewer.

When asked whether they noticed the incoming water or were informed by a fellow subject, 92% of the twenty-six subjects said that they noticed themselves, while only 8% were told. This figure is not significantly different from the results to the same question at Limestone ($\chi^2 = 1.88$, df = 1, $p > .10$). Based upon the results of the $\chi^2$ test statistic, there is no indication that one group of subjects was more or less likely to have noticed the water themselves than the other group. Thus, the subjects were not differentially alerted to what was happening with regard to the swamping of the boats in the two calm water tests (Guntersville and Limestone). This question was phrased carefully, but even so, some subjects may have been reluctant to admit that they did not notice the water until someone else mentioned it.

When the Guntersville subjects were asked what they did, or were going to do, 96% said they stayed or would have stayed with the boat, while only one subject (or 4%) said he left the boat. This result is dramatic and significantly different ($\chi^2 = 12.54$, df = 1, $p < .001$) from the 44% that stayed with the boat at Limestone. The location was different from Limestone, but the distance from shore was approximately the same. The interviews indicated that the behavior difference was due to the labels. Thus, one can attribute the fact that so many more people stayed with the boat in the Guntersville tests than in the Limestone tests to the labels.

The subjects were also asked if they saw any labels. Twenty of the twenty-six subjects, or 77%, reportedly noticed the level flotation label. The subjects reported that they decided to stay with the boat because of the labels, but they did not completely understand the labels. They did not perceive that they were supposed to remain seated in the boat and sit on the floor. Even though only one subject tried to swim for shore, many thought about it. Several stated that they would have tried swimming, but the shore was too far away, and the label said to stay

1) When and how did you first notice that your boat was in trouble?

2) What was your initial reaction? (If you know what it was, i.e., standing up, ask them why.)

3) What did you plan to do next? (Etc. - Continue cycling through events and reactions, stressing what happened, what did you do, how did the boat/environment react, what did you do then....Be sure to include interactions with other "victims.")

4) Did you notice any labels in the boat? Which?

5) What did they say, specifically?

6) (Ask anything that seems appropriate to you.)

FIGURE 7. INTERVIEW QUESTIONNAIRE

"with" the boat. This was curious because the label actually said to stay "in" the boat. This may have been due to previous exposure to literature or messages recommending to stay with the boat. These messages may have been recalled by the subjects in response to the labels. One said he was going to try to paddle the boat in closer and then swim for shore. Four commented that they were going to hang onto the boat for awhile, and then try for shore. One person expressed surprise that the boat filled with water as much as it did. He felt that if the boat had three seats, it could handle three people. Another said the label lead him to believe the boat "would only sink halfway." Finally, several subjects said that they capsized their boats deliberately - "to trap air underneath" - even though the label showed men sitting in an upright johnboat. It appears that the words on the label were much more effective than the picture. The subjects had a tendency to misinterpret the picture more than they misinterpreted the words.

## 5.1 Sample Protocol of Test Subject

The following is a sample protocol from an interview of one of the Guntersville subjects:

Q. When you got out there and the boat started filling up with water, at what point did someone notice and start telling everyone else?

A. Pretty quickly after the other guy left. After he did the thing with the jugs, water started pouring into the boat. We were cracking jokes about looking for signals while the boat was sinking. We all kind of noticed it at once, because water was flowing in everywhere.

Q. Once you saw the boat was on its way down, or that it was going to go down, what did you think you ought to do?

A Stay in it.

Q. What made you think that that was the thing to do?

A. Because of the flotation signs in the boat — STAY IN THE BOAT.

Q. After the boat filled with water, you managed to keep the thing upright for a few minutes. Finally, it turned over. Was that an accident?

A. It was an accident. It just turned over.

Q. After it did turn over, did anybody mention turning it back over or was everyone happy with the way it was?

A. We wanted to turn it back over. That's what we did, but it turned upside-down again.

Q. You probably tried to get back in the boat too fast.

A. Well, we all got back in and sat on the seats, and it seemed unwieldy sitting on the seats.

Q. Did you notice that the picture showed the people sitting on the bottam af the boat, as opposed to the seats?

A. No, we didn't notice that much detail.

Q. If we hadn't picked you up as quickly as we did, what do you think you would have done?

A. If I thought I was gaing to be out there indefinitely, I would have tried to swim to shore.

Q. What if you had been separated from your life jacket (PFD)?

A. I would have swam to the island.

Q. Did you notice any other labels in the boat?

A. No.

## 5.2 Calm Water/Flatation Label Conclusions

The major conclusion af the Guntersville study was that the labels appeared to be very effective in causing the subjects to stay with the level flatatian boat. Althaugh it was nat true that every subject who saw the labels understood them, at least ane subject in each group saw and understaad the labels, ta the extent that he ar she was not gaing ta leave the boat. The Guntersville subjects behaved callectively, with the exception af the one who swam far help, as the subjects had at Limestane. If one subject assumed a leadership role, by choice or example, then the athers followed him.

Although the labels caused the subjects to stay with the boat, they did not cammunicate the "subtle" aspects af level flatatian - to sit low in an upright boat, as shown by the lack of this behavior in Table 3.

Figure 8 depicts a set of subjects at the Guntersville study. These subjects are in a swamped 50/50 johnboat, assessing their predicament.

FIGURE 8. GUNTERSVILLE SUBJECTS

One additional manipulation that was undertaken was to change the capacity plate design to a more colorful one with larger capacity lettering. None of the subjects noticed the capacity plate under either the old or the new design, probably because it was located on the transom and was not clearly visible to most of the subjects.

## 6.0 LEVEL FLOTATION EDUCATION: LECTURE EXPERIMENT

As part of the evaluation of education and level flotation, an experiment was conducted using high school students to determine if the incorporation of a few level flotation slides and comments into a 30 minute boating safety presentation could cause the students to retain some basic knowledge concerning level flotation. The method of presentation and results of the experiment are presented in the following section.

### 6.1 Experimental Design and Presentation

The educational approach chosen to be used in the experiment was to revise and shorten a general boating safety slide/lecture presentation to generate a 30 minute short course on the fundamentals of boating safety, including the meaning and use of level flotation. The USCG's "SOS" course was used as source material. This course was trimmed from 198 slides to seventy-five slides and then five level flotation slides were added. A description of the seventy-five "SOS" slides plus the five level flotation slides used and their content can be found in Appendix B. The five level flotation slides will be described in more detail below.

The first level flotation slide (Figure 9) showed two men sitting low in a swamped level flotation johnboat. All five level flotation slides followed a discussion of capsizings and swampings in the presentation. The text which accompanied this first slide was,

> If your boat is equipped with level flotation, as will be the requirement for most boats in the near future, climb into the boat and sit with the water level up to your waist.

The second level flotation slide (Figure 10) showed three men sitting low in a level flotation johnboat in rough water. The text was read as follows,

> Level flotation will provide a stable platform even in rough weather.

The third slide (Figure 11) showed two men in the water pulling on the gunwale of an overturned level flotation johnboat in an attempt to re-right it. The text accompanying this slide was,

FIGURE 9.

FIGURE 10.

FIGURE 11.

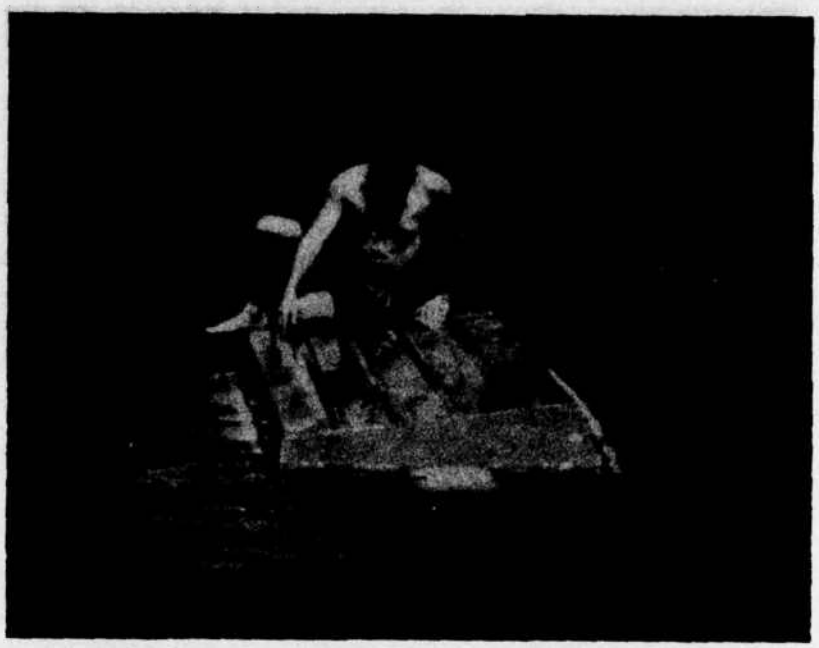


FIGURE 12.

FIGURE 13.

If your boat should invert, try to right it, then climb in.

The fourth slide (Figure 12) depicted a single victim sitting on top of an overturned level flotation johnboat. The text was,

If you can't turn the boat right side up, climb on top of the overturned boat.

The fifth (Figure 13) and final level flotation slide showed six occupants in a small swamped cabin cruiser (approximately 18 ft (5.5 m)) in calm water. The picture was an aerial photograph taken from a helicopter. The accompanying text was,

A boat floating with its deck above water is easier to see from the air should an air search be underway. Remember - Stay with the boat.

These five slides were embedded in the eighty slide presentation. The presentation of the entire course of slides, lecture, and discussion (the students were allowed to ask questions during the course) required approximately 30 minutes.

Two high school algebra classes were used as subjects in the experiment. The first class was given the presentation under the pretense of merely evaluating the course as a possible addition to their curriculum. They were asked to pay attention to the course and comment on the content, instructor, and the appropriateness of the course as a possible physical education elective. Approximately five weeks later, the same class was revisited and given an examination on the course content, including the general boating safety concepts and level flotation. On the second visit, another algebra class was given the same exam. These students had not seen the modified "SOS" course and were used as a control group. A copy of the exam is shown in Figure 14. The comparisons of the responses on the exam from the two classes are used in what follows to analyze the effectiveness of this particular effort in level flotation education.

## 6.2 Lecture Experiment Results and Conclusions

There were twenty-six subjects who had the presentation and thirty-five who did not. For those who had the presentation: fifteen (58%) were in families which owned boats, only one (4%) had had a boating safety course, twenty-six (100%) had been boating at least once,

AGE_____ SEX: M F

Do you or your family own a boat/or boats? Yes___ No___

Have you ever taken a boating safety course? Yes___ No___

Have you ever been boating? Yes___ No___

About how often do you go boating? ___once a week, ___ once a month, ___ once a year, ___ never

Please indicate your answers to the following questions in the blanks provided.

1. The major cause of boating accidents is

   ____ fires

   ____ collisions

   ____ overloading

2. The blower in a boat only needs to be used if the boat has not been used for more than 24 hours.

   ____ True

   ____ False

3. If you see a red flag being displayed by a yacht club, it means

   ____ the yacht club has vacancies for membership

   ____ the weather is bad

   ____ there is a sail boat race in progress - stay away

4. When meeting head to head, which boat has the right of way?

   ____ slower

   ____ faster

   ____ neither

5. When anchoring a boat, let out enough line to just reach the bottom so the line won't get fouled in your prop.

   ____ True

   ____ False

6. If your boat capsizes and remains inverted, you should

   ____ turn the boat right side up and climb in

   ____ climb on top of the overturned boat, stand up and wave/shout for help

   ____ swim for shore immediately

7. In case of fire, jump overboard immediately.

   ____ True

   ____ False

FIGURE 14. EXAMINATION

8. You must cancel your float plan

____ As soon as you return home

____ within 24 hours of your return home

____ with the Coast Guard

9. Boat numbers should never blend in with the color of your boat.

____ True

____ False

10. All boats are required to carry at least throwable PFD's, and some are required to carry wearables as well.

____ True

____ False

11. Portable fuel tanks should be filled while in the boat to avoid spillage in taking them out and replacing them.

____ True

____ False

12. A sail boat ALWAYS has the right of way over a power boat.

____ True

____ False

13. If your boat should capsize, immediately swim for shore to minimize the time you spend in the water.

____ True

____ False

14. In rough water level flotation does not perform satisfactorily.

____ True

____ False

15. In case of emergency, the first thing you do is put on a PFD.

____ True

____ False

16. The carrying capacity of new boats can be found

____ by contacting the Coast Guard

____ by consulting the manufacturer's catalog

____ by looking on the capacity plate

FIGURE 14. EXAMINATION (continued)



35

17. A rowboat or sail boat is required to display lights at night.

____ True

____ False

18. While fueling and after fueling, you should keep all hatches and doors shut to prevent fuel vapors from entering.

____ True

____ False

19. A buoy with an orange circle on it means:

____ a controlled area, read the buoy for the type of control

____ a diver is in the area

____ danger; submerged object

20. If a boat is equipped with level flotation as opposed to basic flotation, it means the boat will:

____ float level with people in the water clinging to it

____ float level with everyone on board moved as far forward as possible

____ float level with everyone on board submerged to his shoulders

____ float level with everyone on board submerged to his waist

21. As soon as a person falls overboard while underway, one should

____ stop the boat

____ throw something over that floats

____ jump in after him/her

22. When docking a boat, remember — it handles just like a car.

____ True

____ False

FIGURE 14. EXAMINATION (concluded)

the average subject went boating more often than once o month, ond the average age was 15.5 years. For those who did not have the presentation: fourteen (40%) were in fomilies who owned boats, three (9%) had had a boating safety course, thirty-five (100%) hod been boating at least once, the average subject went boating more often than once o month, ond the average age was 16.1 years. Thus, the subjects with the presentation were more likely to own o boat, while the other subjects were slightly older, but the overoll frequencies of going boating were nearly identicol. All subjects in both groups had been booting before. These results are summarized in Table 5.

TABLE 5. RESULTS OF LECTURE EXPERIMENT

| | With Presentotion | No Presentotion |
|---|---|---|
| Totol Number of Subjects | 26 | 35 |
| Families Owned Boats | 15 | 14 |
| Had Hod a Boating Safety Course | 1 | 3 |
| Average Age | 15.5 yrs | 16.1 yrs |
| Mean Score, Overoll | 14.1 | 13.3 |
| Meon Score, Level Flotation Questions | 1.6 | 1.9 |

On the exomination, Questions 6, 13, 14, and 20 dealt with level flotation, while the other questions dealt with the other material presented in the course. On the exom os o whole, the students with the presentation had a slightly higher mean score, but the difference between the group with the presentation and those without was not statistically significant ($t = +1.21$, $p > 0.20$). For the questions dealing with level flotation, those without the presentation did slightly better on the average, but again the difference between those with and without the short course was not stotistically significant ($t = -0.91$, $p > 0.20$). Results ore shown in Table 5.

Based on this study of sixty-one high school students (including the group who were exposed to the revised "SOS" course), there was no evidence of appreciable retention of the level flotation messages in the course materials. Indeed, there was little evidence of retention of any of the course materials. This could be due to many things (it was late in the school year, thus we may not have had adequate concentration by the students, the material may not have seemed relevant or important to them, and they were a captive audience). Whatever the reason, the course had little impact as measured by the examinatian.

## 7.0 DISCUSSION AND OVERALL CONCLUSIONS

The three studies at Carderock, Limestone, and Guntersville all involved people and level flotation equipped boats. The major conclusion of the pilot (Carderock) study was that the level flotation johnboats were much safer and easier to control in rough water than the basic flotation johnboat. At Limestone, it was discovered that, in calm water, inexperienced subjects did not realize the benefits of the level flotation or use it - even when the flotation was clearly visible. The Guntersville study showed that the addition of level flotation labels in the johnboat, along with an opportunity for the subjects to observe these labels, resulted in 96% of the subjects staying with the boat. From a behavioral standpoint, it appears that labels are an effective means of level flotation education.

However, what is the message that the label should convey?...and how should it do that? The labels that were used did a good job of relating the message - STAY WITH THE BOAT, even though the actual message was - STAY IN THE BOAT. These labels did not make the subjects realize that they could or should sit low in the boat and maintain the boat upright. Of course, there may be instances when the optimal course of action would be to leave the boat. Research now in progress should help to determine the optimal message that a level flotation education package should deliver. In particular, the message that the label conveys must be relatively short and simple. Future inputs from other programs, such as the Accident Recovery Model in PFD research, and the current education projects, should help to answer some of these questions. ARM preliminary results indicate that staying with the boat is generally beneficial. The ARM data are capable of indicating circumstances where staying with the boat may not be optimal, if such circumstances exist.

Finally, the level flotation education experiment failed to generate measurable educational benefits from altering a shortened boating safety course to include level flotation information. This could have been due to the subjects (high school students), the course, the presentation, or the exam. Whatever the reason, there was no evidence of retention of level flotation information on the part of the subjects.

# APPENDIX A

## DEFINITION OF FLOTATION NOMENCLATURE

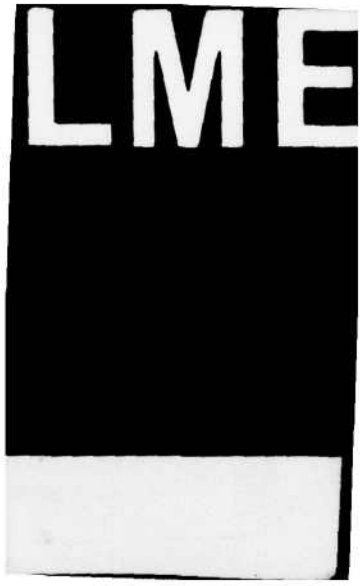
Flotation systems for level flotation are designated by two sets of numbers separated by a slash (e.g., 75/50). The first number (75) denotes the percentage of the persons capacity of the boat that the flotation system can support on centerline in a swamped condition (plus motor, gear, and boat). The second number (50) denotes the percentoge weight of the first number thot the flotation system can support at the side of the boat without exceeding a 30% heel angle. Thus, a 50/50 flotation system can support 50% of the persons capacity on the centerline and 50% of 50% or 25% of the persons capocity ot the side.

Basic flotation provides support for motor and controls, 25% of any gear, and 2/15 of the persons capacity. The boat may float in any attitude while supporting this weight, but must have a portion of the boat above the surface of the water.

## APPENDIX B. OUTLINE OF "SOS" BOATING SAFETY COURSE

The "SOS" boating safety course covers a wide range of boating safety concepts in 198 slides and lecture messages. It is designed to be presented in approximately two hours. The slides are colorful and basically of three types: humorous, dramatic, informational. Slides of all three types were used in the subset of seventy-five slides chosen for inclusion in the level flotation education experiment. The five slides used for level flotation were generally informational, although the slide of six occupants in the swamped level cabin cruiser might be termed slightly dramatic. The following is an outline of the course content for the eighty slides used in the course presented to the subjects:

1. Boating Safety in General: lecture purpose, types of problems to be addressed, some statistics. (6 slides)
2. Boating Laws: capacity plate, numbering, etc. (4 slides)
3. Boat Equipment: PFDs, extinguishers, lights, etc. (15 slides)
4. Pre-Sailing Preparations: trailering, weather check, launching, fueling, etc. (15 slides)
5. Underway: Rules of the Road, buoys/markers, anchoring, courtesy. (13 slides)
6. Emergencies: capsizings, level flotation, fire, man overboard, storms, collisions, etc. (21 slides)
7. Returning Home: docking, loading on trailer, etc. (6 slides)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